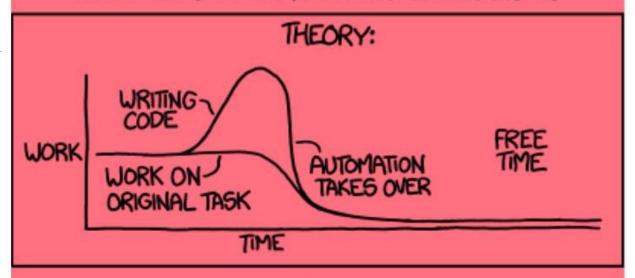
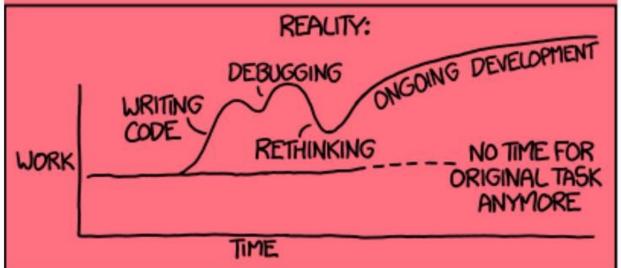


ECE-595 Network Softwarization

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"I SPEND A LOT OF TIME ON THIS TASK. I SHOULD WRITE A PROGRAM AUTOMATING IT!"







The future of digital service delivery from Digital Service Providers (DSPs)

Traditional CSP

- Focus on "elephant" massmarket services that can justify the cost & time
- Expensive and slow to get new service to market due to complex OSS/BSS systems, and manual processes



Cloud Transformation

- Webscales deliver rapid, personalized, on-demand services - leverage cloud automation but mainly over the top delivery
- CSPs starting to evolve with NFV/SDN to speed the delivery of network services



Future DSP

- Digital experience: broad array of new services that combine cloud services and network resources
- Tailor virtual networks for each use case: latency, bandwidth, security, choice of functions
- Agile network: services are rapidly trialed, deployed & scaled
- Open platform: ecosystem of cloud and network players



Source: Analysys Mason

New Markets | Faster New Services | Faster Time to Revenue | Higher Customer Satisfaction



Network Slicing – The foundation for future value creation

Service Request

Slice Request Attributes

Latency:

Throughput:

Reliability:

Mobility:

Geography:

Security:

Analytics:

Cost profile:

Composable Network & Service Resources

Application Logic



Augmented Services



Virtual Network Functions



SW-Defined Connectivity

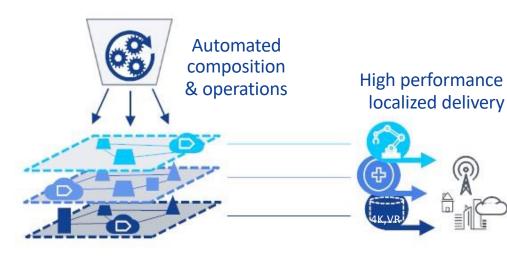


Cloud Infrastructure



Network & Cloud Orchestration

Service Delivery



E2E virtual network optimized for specific tenant, service or service class with dynamic

Service Specific Network Slices

Application

Core

Transport

adaption and automated monitoring and control

Access

E

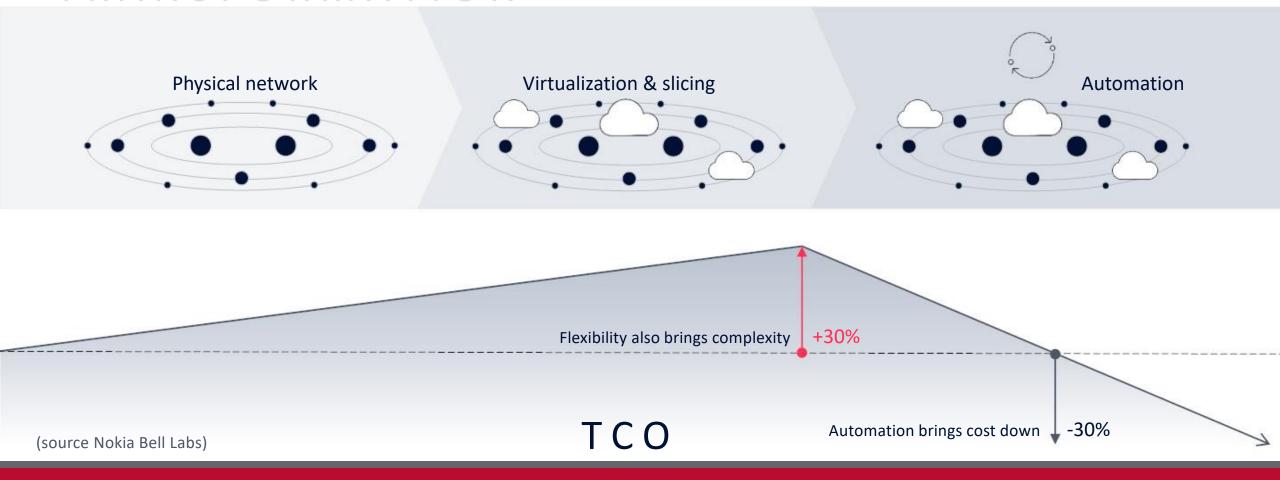
Network slices are end-to-end 'virtual private services'



Virtualization and Slicing are not enough

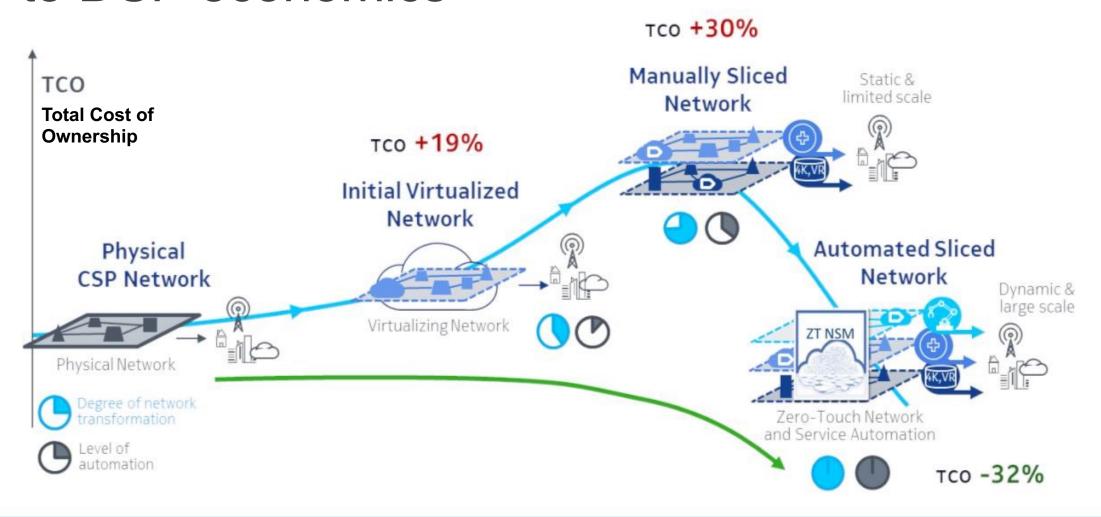
Automation is essential to economics

TRANSFORMATION





Network and Service Automation are essential to DSP economics



Without E2E automation NFV/SDN & network slicing add significant cost and complexity

Source: Nokia

OPERATIONAL SUPPORT SYSTEMS (OSS)

Evolution

PHYSICAL RESOURCES AND INFRASTRUCTURE

DIGITAL STOREFRONT CUSTOMER AND BUSINESS AUTOMATION

DIGITAL SERVICE LIFECYCLE MANAGEMENT (LCM)

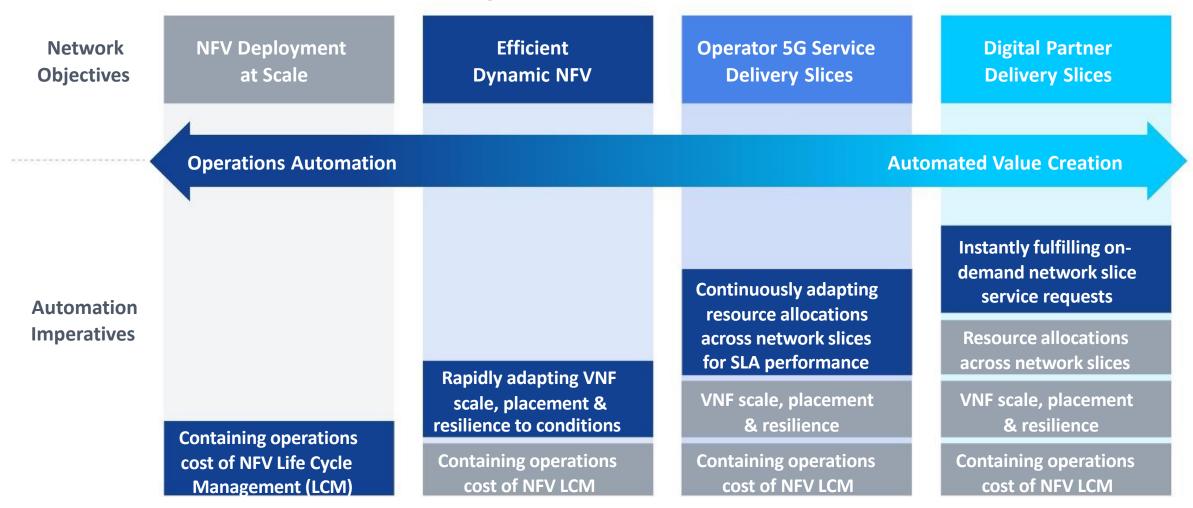
- Service operations
- Network & cloud resource management
- Data layer management

VIRTUAL & PHYSICAL RESOURCES AND INFRASTRUCTURE



CLOUD INFRA

The essential value path from CSP to DSP



Multiple value stages to the automation transformation



Evolution of network management architectures

From silos and custom integration to full multi-domain automation

Increasing operational complexity Operational agility and efficiency Multi-vendor Domains **Network Virtualization Network Automation** Single-Vendor Domains Enterprise Data Enterprise Voice Data Enterprise Voice Data Voice End-End Service Automation Service Service Service Service Service Service Service Service Service Management Management Management Management Management Management Management Management Management Wireless Access Domain Wireless Access Domain Wireless Domain Management Partial Custom Partial Custom Integration Vendor 1 Vendor 2 Vendor 3 Integration Domain Management Automation **EMS** EMS EMS EMS3 EMS4 EMS3 EMS4 Model-Driven Multi-Vendor Resource Control & Monitoring Vendor 1 Vendor 2 Multi-Vendor Network Resources (physical or virtual) 2000 - 2012 1980 - 2000 2012 - 2018 Beyond 2018



Evolution of network management automation

From reactivity to zero-touch automation

Network/service operations

Level of automation

Intelligence

Network agility

Past

Reactive

Low: single task

Descriptive & diagnostic analytics, for example anomaly detection

Static network

Present



Proactive

Partially automated processes

Predictive analytics, e.g. for maintenance/repair

More dynamic with partial software control overlay

Source: adapted from Analysis Mason

Future



Zero-Touch

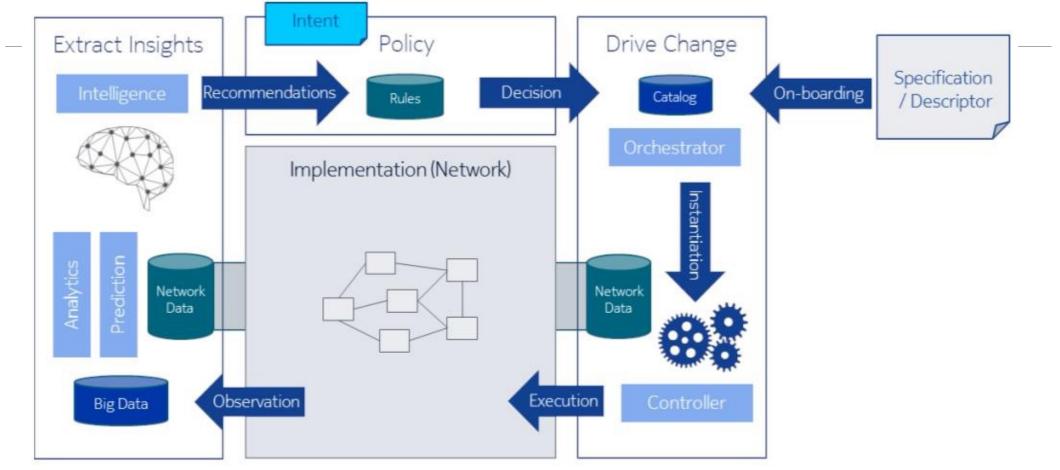
Closed-loop network and service automation

Prescriptive analytics & machine intelligence

Fully programmable with embedded software control



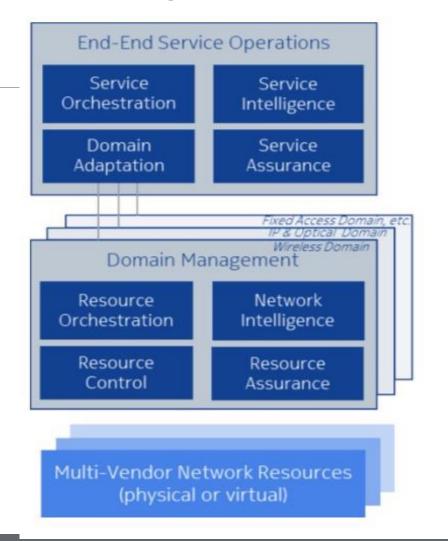
Closed-loop «Zero-Touch» Network Automation



OODA - Observe, Orient, Decide, Act - Closed Control Loop



Future Mobile Operator Architecture



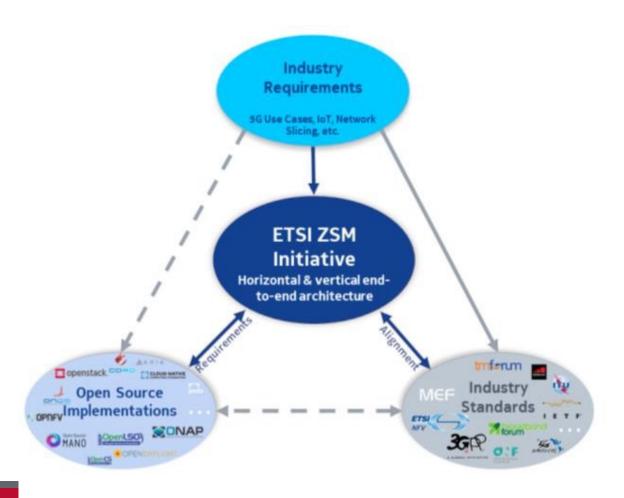
TMForum (*) ETSI ZSM ONAP

ETSI ZSM
3GPP
NGMN
BBF
MEF
IETF
ETSI NFV
ONF
OASIS (TOSCA)

OpenStack Open vSwitch



ETSI Zero Touch Network and Service Management (ZSM)



- ETSI Zero touch network and Service
 Management (ZSM) has a pivotal role in
 bridging between holistic end-end
 automation and other standardization
 bodies or open source projects
 - Requirements derived from use cases
 - Architecture for management/automation
- Open-source projects like ONAP should focus on implementation and validation
- Alignment discussion with LNF and ONAP



ZSM: Automation based on Closed Loops

Act

Domain orchestration services

 Automate workflows and processes to handle instantiation and lifecycle management of the services provided by the domain.

Domain control services

Individually steer the state of each managed entity (resource, consumed service).

Domain intelligence services

Provide domain-specific decisions and recommendations, to drive domain-level closed-loop automation.

Decide

(Source: ETSI GS ZSM002)

Domain analytics services

Provide domain-specific insights based on data collected by domain data collection services and on

Orient

other data.

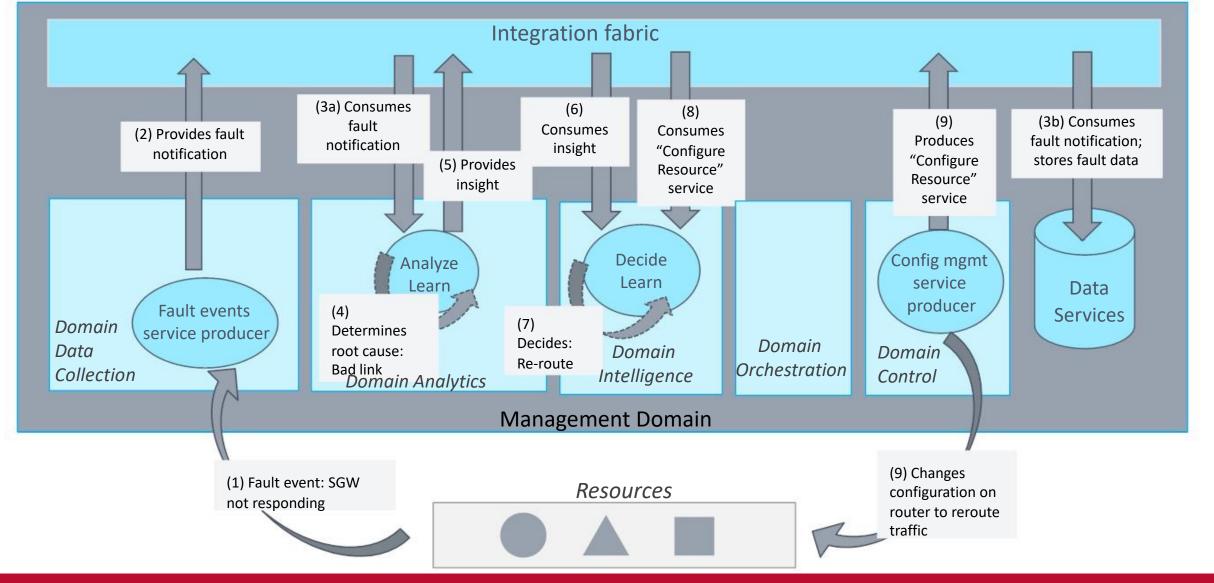


Monitor the managed entities (resources and consumed services), and provide live performance and fault data to support closed-loop automation.

Observe



Closed loop example: Automatic fault mitigation



Intent-based Networking / Automation

Closing the loop between intent and outcome

